

Upper Animas Watershed

10/1/1995

Preliminary Assessment - PASI Sites - PA/SI Watershed - Draft, Animas
Discovery Report - Upper Animas River Basin

PA/2.2./74



PA/2.2./73-01



**Colorado Department
of Public Health
and Environment**

DRAFT

Animas Discovery Report

Upper Animas River Basin

**Prepared by
Camille M. Farrell**

**Colorado Department of Public Health and Environment
Hazardous Materials and Waste Management Division
Preliminary Assessment/Site Investigation Program**

October, 1995

TABLE I
Page 1 of 2

CDPHE Animas Basin Sampling
Draining Mine Adits - Aqueous Sources

Sampling Location	Site Name	Site Location Description
CEMENT CREEK AND ITS TRIBUTARIES		
CC 01	Queen Ann Adit	North Fork of Cement Creek Headwaters
CC 01b	Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01c	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01d	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01e	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01f	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 10	Middle Fork Cement Adit	Middle Fork of Cement Creek Headwaters
CC 14	South Fork Cement Adit	N. trib. of S. Fork of Cement Cr. Headwaters
CC 19	American Tunnel	Cement C. below the confluence with Minnehaha
CC 24a	Prospect Adit	Mainstem of Prospect G.
CC 24b	Prospect Adit	Mainstem of Prospect G.
CC 29	Cement Adit	Trib. west of Cement Cr., below Prospect G.
CC 29a	Cement Adit	Trib. west of Cement Cr., below Prospect G.
CC 32	Cement Adit	Mainstem of Cement Creek
CC 37	Anglo Saxon Adit	Mainstem of Cement Creek
CC 37a	Anglo Saxon Adit	Mainstem of Cement Creek
CC 44	Topeka Adit	Mainstem of Cement Creek
MINERAL CREEK AND ITS TRIBUTARIES		
M 02a	Longfellow/Koehler Complex	Mineral Creek Headwaters
M 02b	Longfellow/Koehler Complex	Mineral Creek Headwaters
M 09	Mill Creek Adit	Upper Mill Creek
M 11a	Adit Below Beaver Ponds	Mainstem of Mineral Creek below Mill Cr.
M 12a	Browns G. Adit	Browns Gulch
M 12b	Browns G. Adit	Browns Gulch
M 21	Bonner Adit	Lower Middle Fork of Mineral Creek
M 21a	Bonner Adit	Lower Middle Fork of Mineral Creek
M 24	Bandora Adit	South Fork of Mineral Creek Headwaters
M 36	Mineral Creek Adit	Mineral Creek before confluence with Animas
M 37	Mineral Adit	Mineral Creek before confluence with Animas

From: Owen, 1994

TABLE II

**Comparison of CDPHE(1) Existing Data to EPA(2) HRS Requirements
UPPER ANIMAS FIELD MEASUREMENTS**

Sample Location		Field Parameters		Field QA/QC	
CDPHE	EPA	CDPHE	EPA	CDPHE	EPA
Background (water)	Background (water)	Temp.	Temp.	1 Field Blank per 18 samples (average)	1 Field Blank per 20 samples (blind)
Aqueous Sources (draining mine adits; mine waste seeps; natural seeps)	Aqueous Sources	pH	pH	1 Rinsate Blank per 18 samples (same as filtered field blanks)	1 Rinsate Blank per day (1 per 20 samples)
+++	Solid Sources	EC	EC	Not Applicable	1 Trip Blank per trip (VOA only)
Surface Water	Surface Water	Discharge (High and low flow)		1 Duplicate per 13 samples (average)	1 Duplicate per 20 samples (blind)
	Sediments	Discharge (storm event)			

Field Blank = Quality Control to assess potential field contamination

Rinsate Blank = Quality Control to assess field decontamination procedures

Trip Blank = (For VOC's) Quality Control to assess sample handling/shipping procedures

+++ = Sampling of solid sources scheduled during future "Site Characterization" of specific sub-basins

(1) Owen, 1994.

(2) Martinez, 1995.

TABLE III

**Comparison of CDPHE(1) Existing Data to EPA(2) HRS Requirements
UPPER ANIMAS LABORATORY MEASUREMENTS**

Analytical Parameters		Analytical Methods (EPA Methods)		Detection Limits(ug/L)		Laboratory QA/QC		Laboratory Data Validation for Inorganics Analyses	
CDPHE	EPA	CDPHE	EPA	CDPHE	EPA CRDL	CDPHE	EPA	CDPHE	EPA
Aluminum	Aluminum	200.7; ICP	200.7; ICP	50	200	1 Spike per 10 samples	1 Spike per 20 samples	Holding Times: 6 mo; pH<2; (Hg<28 days)	Holding Times: 6 mo; pH<2; (Hg<28 days)
	Antimony		200.7; ICP 204.2; GFAA		60	1 Instrument Blank per 10 samples	1 Instrument Blank per 20 samples	Calibration: once/day	Calibration: once/day
Arsenic	Arsenic	206.3; HYDRIDE	206.2; GFAA	1	10	1 Duplicate per 10 samples	1 Duplicate per 20 samples	Blanks: No contamination	Blanks: No contamination
	Barium		200.7; ICP		200			ICP Interference Check: 1x/8-hrs	ICP Interference Check: 2x/8-hrs
	Beryllium		200.7; ICP 210.2; GFAA		5			Lab Control Sample: +/- 20%	Lab Control Sample: +/- 20%
Cadmium	Cadmium	200.9; GFAA	200.7; ICP 213.2; GFAA	0.25	5			Duplicate Sample: +/- 20%	Duplicate Sample: +/- 20%
	Calcium		200.7; ICP		5000			Matrix Spike: +/- 20%	Matrix Spike: +/- 25%
Chromium	Chromium	200.7; ICP 200.9; GFAA	200.7; ICP 218.2; GFAA	10 5	10			Furnace AA QC: spikes = +/- 15%	Furnace AA QC: spikes = +/- 15%
	Cobalt		200.7; ICP		50			ICP Serial Dilution: +/-10%	ICP Serial Dilution: +/-10%
Cr	Copper	200.7; ICP 200.9; GFAA	200.7; ICP	4 5	25			Sample Result Verification	Sample Result Verification
Cyanide	Cyanide	335.1; COLORIMETRIC	335.2	10	10			Field Duplicates	Field Duplicates
Iron	Iron	200.7; ICP	200.7; ICP	10	100			Overall Data Assessment	Overall Data Assessment
Lead	Lead	234.2; GFAA	200.7; ICP 239.2; GFAA	5	3				
Magnesium	Magnesium	200.7; ICP	200.7; ICP	1000	5000				
Manganese	Manganese	200.7; ICP	200.7; ICP	4	15				
Mercury	Mercury	245.1; MANUAL COLD VAPOR	245.1; MANUAL COLD VAPOR 245.2; AUTO COLD VAPOR	0.2	0.2				
Nickel	Nickel	200.7; ICP	200.7; ICP	20	40				
Potassium	Potassium	200.7 ICP	200.7; ICP		5000				
Selenium	Selenium	SM31114B; HYDRIDE 270.3; HYDRIDE	270.2; GFAA	1	5				
Silver	Silver	272.2; GFAA 200.9; GFAA	200.7; ICP 272.2; GFAA	0.2 0.2	10				
Sodium	Sodium	200.7 ICP	200.7; ICP		5000				
	Thallium		200.7; ICP 279.2; GFAA		10				
	Vanadium		200.7; ICP		50				
Zinc	Zinc	200.7; ICP	200.7; ICP	8	20				
	ORGANICS								

ICP = Inductively Coupled Plasma
GFAA = Graphite Furnace Atomic Absorption

EPA CRDL = EPA Contract Required Detection Limit

(1) Alexander, 1995.
(2) EPA, 1994.

4.4 Usability of Existing CDPHE Data

Upon review of the EPA HRS data requirements and the data previously collected by CDPHE, it seems that the Data Quality Objectives, sampling locations, sampling methods, analytical methods, required detection limits (except for lead) field and laboratory QA/QC measures and data validation requirements are comparable. Differences between what EPA would have included in a Site Investigation and what CDPHE has thusfar collected appear to be limited to:

- 1) analyses of antimony, barium, beryllium, cobalt, thallium and vanadium inorganic parameters;
- 2) analyses of organic parameters;
- 3) analyses of sediments (collocated with surface water) samples;
- 4) detection limits for lead (CDPHE = 5ug/L, whereas EPA = 3ug/L); and,
- 5) CDPHE Lab conducts ICP Interference Checks once every 8 hours, whereas EPA conducts these checks twice in 8 hours.

Sampling conducted in Cement Creek and the Upper Animas basins by Standard Metals and Sunnyside Gold Corporation between 1981 and 1993 reported the following concentrations of those metals (excluding cobalt) not sampled for by CDPHE (Perino, 1995):

TABLE IV SUNNYSIDE GOLD CORPORATION'S CEMENT CREEK AND ANIMAS RIVER SAMPLING SELECT METALLIC PARAMETERS						
Parameter Sampled	Cement Creek above the American Tunnel Concentrations reported in ug/L			Animas River above Boulder Creek Concentrations reported in ug/L		
	September 1986	September 1991	February 1993	September 1986	September 1991	February 1993
Antimony	< 10	0		< 10	0	
Barium	300	0		400	0	
Beryllium	1	2		< 1	0	
Thallium	< 100	0		< 100	0	
Vanadium			< 10			< 10

Water quality analyses of 89 water quality samples from 49 draining mine sites (aqueous sources) were collected and analyzed by the U.S. Bureau of Mines as part of their field inventory of abandoned mine lands on Bureau of Land Management administered lands in the upper Animas River Watershed, conducted during the summer and fall of 1994 (U.S.BOM, 1995). Amongst other parameters analyzed, the range of concentrations for those metals not analyzed for by CDPHE, except antimony and thallium, follow (Hite, 1995):

Antimony:	not analyzed;	EPA CRDL = 60 ug/L
Barium:	< 2 - 97 ug/L;	EPA CRDL = 200 ug/L
Beryllium:	< 1 - 3 ug/L;	EPA CRDL = 5 ug/L
Cobalt:	< 3 - 46 ug/L;	EPA CRDL = 50 ug/L
Thallium:	not analyzed;	EPA CRDL = 10 ug/L
Vanadium:	< 6 - 6 ug/L;	EPA CRDL = 50 ug/L

protection of aquatic life and its uses for mercury at 0.012 ug/L, below the EPA CRDL. This discussion has been incorporated into Section 5 of the Animas discovery Report.

Variations in metal concentrations and loadings are compared in the three streams in which aquatic life is not present: Animas River; Cement Creek; and, Mineral Creek. Stream reaches and sampling site locations are illustrated in Figure 1. Analytical results, by sampling site, are provided in Appendix A.

5.1 Animas River

The Animas River below the confluence of California Gulch and North Fork of the Animas (sample location A-14) has high concentrations of dissolved aluminum, cadmium, copper, manganese, and zinc. This was the only site on the mainstem with detectable concentrations of dissolved lead. Although Burns Gulch and Eureka Gulch contribute significant quantities of dissolved metals to the Animas River, the concentration of all trace metals in the mainstem of the Animas shows a general decrease from the Animas Forks (A-14) to Cement Creek (A-68). Dilution from tributaries including Cinnamon Creek, Grouse Gulch, Pacayne Gulch, Minnie Gulch, Maggie Gulch and Cunningham Creek, in which trace metal concentrations are low or absent, decreases the concentration of these metals. In spite of the lowering of concentration of most metals between Animas Forks and Cement Creek, zinc continuously remains at a level that is toxic to several forms of aquatic life.

The mainstem of the Animas has the highest pH of the three streams, ranging between 7 and 8. The higher pH contributes to precipitation of several metals, particularly aluminum, copper, lead and iron. Thus, the ratios of dissolved to total recoverable metals are generally lower in the Animas than in Cement or Mineral Creeks.

The largest contributors of zinc loading to the upper Animas, shown in Figures 2a and 2b, are California Gulch, Eureka Gulch, Burrows Gulch and Burns Gulch, respectively.

Several draining adits and waste piles are located in California Gulch and Placer Gulch, a tributary to California Gulch (TABLE I).

Eureka Gulch accounted for over 25% of the zinc load to the Animas during the October sampling period. Drainage from Sunnyside Gold's Terry Tunnel, which is treated except for when it is inaccessible during the winter, drains into Eureka Gulch.

Zinc loading to the Animas between Eureka Gulch and Cement Creek is small. Aluminum, copper and iron loading to the Animas River is relatively small compared to Cement and Mineral Creeks.

As depicted in Figure 3, upper Animas watershed is comprised primarily of public lands managed by the U.S. Bureau of Land Management (BLM), largely interspersed with patented mining claims (private ownership). Surface Management of the Bureau of Reclamation's (BOR) "Reclamation Withdrawal" near Middleton and Howardsville, approximately four miles north of Silverton, southeast of the Animas River, is also under the jurisdiction of the BLM. The BOR has recommended that these withdrawals be revoked and the encumbrance to the land cleared (Hoffman, 1995).

5.2 Cement Creek

The mainstem and most of the tributaries of Cement Creek have concentrations of dissolved aluminum, cadmium, copper, iron, lead, manganese and zinc that are acutely and chronically toxic to most forms of aquatic life. In contrast to the Animas River, the pH of Cement Creek is consistently less than 5 throughout the watershed, with values as low as 2.9 measured in several tributaries. The low pH in Cement Creek is partly attributable to the surface exposure of pyrite throughout the basin.

Zinc loading in the Cement Creek watershed is from four general areas, as illustrated in Figure 4. They include the North Fork of Cement Creek, South Fork Cement Creek, the mainstem above North Cement Creek, and Prospect Gulch.

Approximately one half of the zinc loading is derived from the upper part of the basin (above CC-05).

The North Fork of Cement Creek, the South Fork of Cement Creek, and Prospect Gulch appear to be significant contributors of zinc during the spring runoff; however, during baseflow, the North Fork appears to be a minor source. Loads were highest during the June, 1991 (high-flow) and September, 1991 (storm) sampling events, when runoff was the highest.

Sunnyside Gold Corporation's American Tunnel discharges into Cement Creek. Prior to treatment, the zinc concentration in the American Tunnel drainage exceeds 15,000 micrograms per liter (ug/L); the treated concentrations averages 300 ug/L total recoverable zinc. The treated American Tunnel drainage constitutes a minor zinc loading source to Cement Creek.

An apparent large natural source of iron and zinc is associated with an iron bog adjacent to Cement Creek between Prospect Gulch and Minnesota Gulch, accounting for approximately 44% of the zinc load to Cement Creek during the October, 1992 sampling event.

Ohio Gulch appears to be a large contributor of iron during the rainfall runoff sampling event of September, 1991.

As depicted in Figure 3, the Cement Creek watershed is primarily comprised of public lands managed by the BLM, and largely interspersed with patented mining claims (private ownership).

5.3 Mineral Creek

Dissolved cadmium, copper and zinc are high in Mineral Creek from near the summit of Red Mountain Pass to the Animas River near Silverton. The highest concentrations of these metals are found between the summit of Red Mountain Pass and Chattanooga; dilution significantly decreases the concentration of cadmium, copper, and zinc towards Silverton. The Middle Fork of Mineral Creek is the largest contributor of acid water, aluminum, and iron to Mineral Creek. The pH of Mineral Creek is highly variable. Acid from the mining area at the summit of Red Mountain Pass and from the Middle Fork of Mineral Creek severely depresses the pH; however, high stream flows dilute the acidity.

The Longfellow Mine-Koehler Tunnel complex, near the summit of Red Mountain Pass, is the most significant source of cadmium, copper, and zinc in Mineral Creek. This area also produces a significant amount of acid water. Figure 5 illustrates that other sources of zinc loading in the Mineral Creek Watershed are relatively minor.

The Middle Fork of Mineral Creek is the largest source of aluminum and iron in the upper Animas Basin. These constituents impact aquatic life in both Mineral Creek and the Animas River below Mineral Creek. As depicted in Figure 3, land ownership in the Mineral Creek watershed is primarily public, managed by the U.S. Forest Service, interspersed with patented mining claims (private ownership).

6.0 CURRENT ACTIVITY IN THE BASIN

There is currently a collaborative effort of key interests in the Upper Animas River Basin to address the severe impacts to aquatic life due to heavy metals contamination. The Animas River Stakeholders, as they are known, are comprised of a core group of approximately 30 individuals representing the U.S. Bureau of Land Management; U.S. Bureau of Mines; U.S. Bureau of Reclamation; U.S. EPA; U.S. Forest Service; U.S. Geologic Survey; Colorado Department of Natural Resources (DNR), Division of Minerals and Geology; Colorado DNR, Division of Wildlife; CDPHE, Hazardous Materials and Waste Management Division; CDPHE, Water Quality Control Division; Sunnyside Gold Corporation; Southwest Water Conservancy District; San Juan County; Durango and Silverton local governments; and local citizens.

The Stakeholders themselves and the participating entities in the Stakeholders group are involved in specific activities, which they bring to the group for information sharing, group involvement, coordination of basin projects, etc. Current "Specific Activities" currently ongoing in the Basin are presented by participating entities as follows:

6.1 PARTICIPATING PARTIES

6.1.1 Animas Stakeholders

The Stakeholders meet monthly (since February, 1994) to plan and coordinate implementation projects aimed at remediating sources of heavy metal pollution to the Animas River with the mission of improving water quality and aquatic habitats in the Animas Watershed in southwestern Colorado. Additionally, they keep each other apprised of local and governmental efforts, both ongoing and planned, aimed toward improving water quality in the Upper Animas Basin, thereby coordinating and incorporating those projects into their ongoing efforts.

Figure 6 identifies the tributaries of the Animas Watershed identified by the Animas Stakeholders Group as sources of heavy metal pollution and which are currently being focusing upon for development of remedial activities to mitigate the pollution, i.e., the mainstem of the Animas River below the confluence with Mineral Creek; the mainstem of Mineral Creek and its tributaries including the North Fork, Middle Fork and South Fork; the mainstem of Cement Creek and its tributaries including South Fork, Middle Fork, and Prospect Gulch; and tributaries to the upper Animas, including Placer and Picayune Gulches.

Figure 7 presents the schedule that the Animas Stakeholders are following to address the various phases of project development:

- (I) Monitoring/General Investigation;
- (II) Feasibility Studies/Remediation Plan Development; and,
- (III) Remedial Action Plan Implementation.

The Stakeholders, as a collective entity, have organized themselves into three "working groups" to investigate and implement various project components and needs. The Monitoring Working Group focuses on the collection, assessment, and management of data as well as the identification of source areas contributing to heavy metals contamination. The Funding Working Group focuses on the investigation of, and securing funding opportunities for monitoring and remediation projects. The Feasibility Working Group focuses on conducting feasibility studies to identify alternatives for remediating source areas and implementation of remediation projects.

6.1.8 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) funded the CDPHE Water Quality Control Division Non-point Source Program (NPS) to conduct the 1991-1993 upper Animas Basin water sampling effort. Additionally, the EPA is currently funding the Animas Basin Coordinator position through the Rocky Mountain Headwaters Initiative. Additional funding may be provided for future NPS investigations and demonstration/remediation projects.

EPA has assembled a team of individuals from various EPA programs to focus on the Animas Basin to address the region from a Watershed Protection Approach. Representatives from EPA's Groundwater, Stormwater, Headwater, Superfund, Site Assessment, Historical Preservation, NEPA, Wetlands, and Native American Tribes programs, in addition to EPA's General Counsel, focus on Animas watershed issues including, but not limited to: mining; hydrologic modifications; the Animas/La Plata Reservoir; landfill closures; septic tank density; and coalbed methane issues. The EPA hopes that the Animas Group, as they are termed, will fulfill supportive and education role to the Animas Stakeholders Group (Russell, 1995).

This document serves as a summary of existing heavy metal source data in the Upper Animas River Basin, (in and around Silverton, Colorado) to determine sites or geographic regions which may need to be addressed via EPA's Site Assessment program. The primary objective of the site assessment program is to obtain data necessary to identify the highest priority sites posing threats to human health and the environment.

6.1.9 U.S. Forest Service

The U.S. Forest Service (USFS) manages public lands in the Mineral Creek Basin. The USFS is planning on surveying and generating topographic maps of mine site areas located on federal and private lands (if access is authorized) in the Mineral Creek basin during the 1995 field season. USFS may be able to provide geologic mapping of the same area. USFS is able to assist the biological monitoring endeavors of the Animas Stakeholders group in the Animas Canyon by providing laboratory analyses of macroinvertebrates. Additionally, USFS will be coordinating with the Colorado Geologic Service to inventory inactive mine sites located on USFS lands in the upper Animas Basin.

6.1.10 U.S. Geological Survey

The U.S. Geological Survey (USGS) monitors streamflow at four gaging stations, one on the Upper Animas River below Silverton and the three main tributaries (Mineral Creek, Cement Creek and the Animas River) upstream from that site. The USGS collects water-quality samples quarterly at the Animas River below Silverton and assists the BOR, CDPHE and the Colorado Division of Wildlife, River Watch Program, with water quality sampling at the three main tributary sites, in particular during streamflows that cannot be waded. Personnel from the USGS are involved in the coordinating water quality sampling and providing advice on sampling techniques to groups and agencies working in the area.

The USGS is investigating sources of metals contributions from natural sources in the Upper Animas. The investigation is focusing on the use of oxygen isotopes to differentiate between flows from unmined and mined areas. Preliminary work done in the Cement Creek Basin indicates that the use of oxygen isotopes can be used to differentiate between flows. Funding is being sought for additional fieldwork to verify and test the method. Currently a document is being prepared describing the findings from this study to date. As part of a region-wide investigation, the USGS collects snow chemistry data in the vicinity of Red Mountain Pass. The USGS has been investigating and mapping the geology of the Upper Animas Basin and is available to advise groups working in that area (USGS, 1995).

6.1.11 Colorado Division of Wildlife

The Colorado Division of Wildlife (DOW) manages the Riverwatch Program, whereby water quality data is collected by school students in various towns and cities throughout Colorado. Silverton School students sample within the Animas River basin on a monthly basis during the months of September through February, 2x/month in March and August, 3x/month in April and July and 4x/month in May and June. Temperature, alkalinity, hardness, pH, and dissolved oxygen readings are collected in the field; samples are collected, and analyzed by the DOW, for total and dissolved cadmium, copper, iron, lead, manganese and zinc at the following locations: Animas River at the 13th Street bridge; Cement Creek; and, in the Animas Canyon, below the confluence with Mineral Creek.

Additionally, the DOW conducts biological sampling of the Animas River which can assist in the Animas Stakeholders Group biological sampling efforts in the Animas Canyon (Horn, 1995).

CDPHE sampling focused on the surface water pathway, targeted on the impact to aquatic habitat. Fisheries exist in the Animas River between Maggie Gulch and Cement Creek; however, aquatic life is not supported in the Animas River above Maggie Creek; Cement Creek; and the mainstem and Middle Fork of Mineral Creek, due to heavy metal pollution (Owen, 1995). The mission of the Animas Stakeholders group is to improve water quality and aquatic habitats in the Animas Watershed in southwestern Colorado. Fish Tissue Analyses were conducted by the BOR in the lower Animas basin. Mercury in fish tissue ranged from 0.0066 to 0.22 ug/g of mercury (wet weight). Sediments were also analyzed by the BOR in the lower basin.

Aqueous source sampling was conducted at approximately 50 draining mine adits, seeps from mine waste piles, and naturally occurring seeps (Table I). Solid source sampling, i.e., mine waste piles including tailings and waste rock, is scheduled for future site characterization work. Mineral Creek and its tributaries will be "characterized", i.e., collection of qualitative and quantitative site information and sampling, similar to EPA's Preliminary Assessment and Site Investigation programs, by the CDPHE and the Colorado Division of Minerals and Geology during the summer of 1995. "Site Characterization" of sites in other tributaries are scheduled pursuant to the Animas Stakeholders Group prioritization (Sections 6.1.1, 6.1.4 and Figure 7).

8.0 REFERENCES

- Alexander, Sharri, 1995. Colorado Department of Public Health and Environment, Inorganic Laboratory, Denver, Colorado. Telephone conversations, April.
- Baum, Michael, 1995. Mining Remedial Recovery Company, Price, Utah. Telephone conversation, February, 1995.
- Bucknam, David, 1995. Colorado Department of Natural Resources, Division of Minerals and Geology, Denver, Colorado. Telephone conversation, February, 1995.
- Colorado Center for Environmental Management, 1995. *Animas River Demonstration Project - Status Report Executive Summary*, January 13, 1995.
- Colorado Department of Health, 1984(a). Hazardous Materials and Waste Management Division, Denver, Colorado. *Site Investigation Report: Standard Metals Mayflower Mill*. June 27.
- Colorado Department of Health, 1984(b). Hazardous Materials and Waste Management Division, Denver, Colorado. *Site Investigation Report: Standard Metals Sunnyside Mine*. July 27.
- Colorado Department of Health, 1988. Water Quality Control Division, Denver, Colorado. *Standard Operating Procedures*.
- Colorado Department of Health, 1994. Hazardous Materials and Waste Management Division, Denver, Colorado. *Preliminary Assessment: Kendrick & Gelder Smelting Company, San Juan County, Colorado*.
- Colorado Department of Public Health and Environment, 1991. Disease Control and Environmental Epidemiology Division. *Position Paper for Draft Colorado Health Advisory for Consumption of Fish Contaminated with Methylmercury*. May.
- Colorado Department of Public Health and Environment, 1994. Hazardous Materials and Waste Management Division, Denver, Colorado. *Support Agency Workplan - Preliminary Assessment and Site Inspection Program - October 1, 1994 - September 30, 1995*. August, 1994.
- Colorado Department of Public Health and Environment, 1995. Hazardous Materials and Waste Management Division, Denver, Colorado. *Site Inspection Sampling and Analysis Plan - Cortez Ore Location, Montezuma County - February, 1995*.
- EPA, 1992(a). Hazardous Site Evaluation Division - Office of Solid Waste and Emergency Response, Washington D.C. *Guidance for Performing Site Inspections Under CERCLA, Interim Final, September*. EPA540-R-92-021.
- EPA, 1992(b). Region VIII, Denver, Colorado. *Region VIII Site Investigation Program Quicksheet: Evaluating Existing Data*.
- EPA, 1994. Office of Solid Waste and Emergency Response. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*. EPA/540/94/083. December.
- Frohardt, Paul, 1994. Colorado Department of Public Health and Environment, Water Quality Control Commission, Denver, Colorado. *Memorandum Regarding Draft Preliminary Final Action Documents*, November 22, 1994.

- Goodhard, Bill, 1995. Sunnyside Gold Corporation, Silverton, Colorado. Telephone conversation, February, 1995.
- Hite, Barbara, 1995. U.S. Bureau of Mines, Denver, Colorado. Clarification of Draft Animas Discovery Report and telephone conversation, April.
- Hoffman, Kent, 1995. U.S. Bureau of Land Management, Durango, Colorado. Clarifications of Draft Animas Discovery Report.
- Horn, Barbara, 1995. Colorado Department of Natural Resources, Division of Wildlife, Denver, Colorado. Telephone conversation, February, 1995.
- Krabacher, Paul, 1995. Colorado Department of Natural Resources, Division of Minerals and Geology, Grand Junction, Colorado. Telephone conversation, February, 1995.
- Martinez, Jeff, 1995. U.S. EPA, Region VIII, Denver. Telephone conversations, April.
- Owen, Bob, 1994. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado. *Memorandum Regarding Draft Report, Animas River Loading Analysis, December 30, 1994.*
- Owen, Bob, 1995. Colorado Department of Public Health and Environment, Water Quality Control Division, Denver, Colorado. *Draft Mineral Creek Sampling Plan, January, 1995.*
- Perino, Larry, 1995. Sunnyside Gold Corporation, Silverton, Colorado. Telephone conversation, April.
- Russell, Carol, 1995. U.S. EPA, Region VIII, Denver, Colorado. Telephone conversation, February, 1995.
- Simon, Bill, 1995. Animas Basin Coordinator, Durango, Colorado. *Summary of February 8, 1995 meeting of the Eureka Workgroup.*
- Simon, Bill, 1995. Animas Basin Coordinator, Durango, Colorado. Clarification of Draft Animas Discovery Report.
- U.S. Bureau of Land Management, 1990. *Surface Management Status 1:100,000-scale Metric Topographic Map of Silverton Colorado. Durango NW/4. BLM Edition.*
- U.S. Bureau of Mines, 1995. Intermountain Field Operations Center, Denver, Colorado. *Abandoned Mine Land Inventory of BLM Administered Land in Upper Animas River Watershed, Colorado. February.*
- U.S. Bureau of Reclamation, 1992. Durango Projects Office, Durango, Colorado. *Animas River Trace Element Toxicity Study.*
- U.S. Bureau of Reclamation, 1995. Denver Office, Denver, Colorado. *Animas La Plata Project Sediment Analyses. May.*
- U.S. Geological Survey, 1995. Colorado District, Water Resources Division, Grand Junction Colorado. Clarification of Draft Animas Discovery Report.